

GSFC ESDIS CMO
December 18, 2018
Released

423-RQMT-003, Revision B
Earth Science Data and Information System (ESDIS)
Project, Code 423

Metadata Requirements – Base Reference for NASA Earth Science Data Products



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Preface

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Abstract

This document defines the NASA Earth Science Division base metadata requirements for science data products of satellite mission data systems. The metadata requirements represented in this document are a means of assuring the consistency of data requirements across subsystems, and supporting the data standardization necessary for system interoperability. Metadata details, including schema for required and optional elements, are captured in the Appendices to this document, which are published as stand-alone documents.

Keywords: *datasets, Earth Science Data, ESDIS, granules, ISO, metadata, products, series, UMM, ECHO, DIF, CMR*

Change History Log

Revision	Effective Date	Description of Changes PAGES AFFECTED CCR APPROVED DATE
Original	12/01/2011	CCR 423-ESDIS-5; CCB approved 12/01/2011 Pages: All
Rev A	01/25/2018	CCR 423-ESDIS-171; CCB approved 01/25/2018 ALL – Administratively extend expiration for 1 year anticipating revision
Rev B	12/18/2018	CCR 423-ESDIS-193, approved 10/10/2018 Revise core and baseline appendices as stand alone docs. Pages: All; See DCN for full detail

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1 INTRODUCTION

1.1 Purpose

Metadata serves a multitude of purposes. Missions typically list information about the instrumentation, the flight vehicle, the data gridding method, the temporal and spatial extent of the data, the operational plan and flight dynamics information. Distributed Active Archive Centers (DAACs) employ metadata to enable product ordering, sub-setting, merging and visualization. In addition, metadata provide users with descriptions of data product structure, lineage, algorithms and the quality of the content.

The Common Metadata Repository (CMR), and the Unified Metadata Model (UMM) that the CMR utilizes, supports and merges critical components from key metadata formats commonly used by current data providers (ECHO10, GCMD DIF-10.x, ISO 19115-1, ISO 19115-2 SMAP, and ISO 19115-2 MENDS), allowing ESDIS to provide consistent metadata across its collection. The UMM Profiles, and key metadata elements captured within them, are further described in section 3 of this document and fully reflected in the Appendices to this document.

The CMR provides an Application Programming Interface (API) to facilitate the discovery, online access, and delivery of a Data Partner's data holdings; it is the responsibility of the CMR Data Partners to add new metadata, remove old metadata, and modify and control access to existing metadata used in search and discovery of data products. While, a small set of metadata attributes may be sufficient for the most common spatial, temporal and parameter based queries, rich and fully populated metadata allows data users to better understand the underlying data product.

A Data Partner is an entity that provides data directly to Earth Observing System Data and Information System (EOSDIS) and CMR (typically a DAAC, though there are some exceptions). If a data producer provides data to a DAAC who then passes it along to CMR for further distribution, it is the DAACs responsibility as the CMR Data Partner to ensure the metadata in all the data they send to CMR meets the requirements described herein; this may be done by working with the data producer to populate necessary metadata fields. The figures below show a simple and more detailed depiction of the CMR API interface:

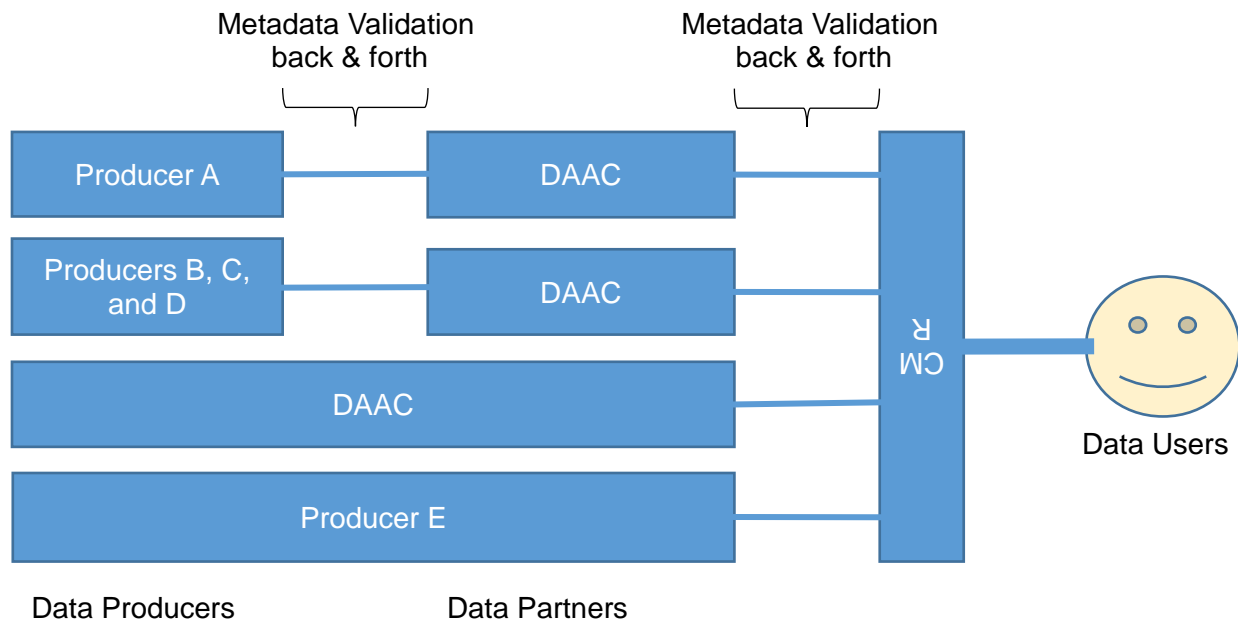


Figure 1-1. CMR Ingest

Figure 1-2. CMR Ingest Methods

1.2 Scope

This document specifies an ESD implementation for NASA Earth Science metadata products of EOSDIS provider data systems. Appendices to this document, published as stand-alone documents, specify metadata schema and other information in detail. Distribution of this document and corresponding Appendices are unlimited.

1.3 Organization

Section 1 provides information regarding the scope, purpose, and organization of this document; lists related documents that were used as sources of information for this document or that provide additional background information to aid understanding of the base reference model.

Section 2 provides information for the base reference metadata model.

Section 3 lists abbreviations and acronyms.

Appendices will include finalized Unified Metadata Model (UMM) documentation.

NOTE: The use of term “dataset” in NASA Earth Science Data Systems (ESDS) metadata conflicts with ISO terminology. In ISO, “dataset” means “granule”. In NASA ESDS, “dataset” means “collection”.

1.4 Related Documentation

The latest versions of all documents below should be used. The latest ESDIS Project documents can be obtained from URL: <https://ops1-cm.ems.eosdis.nasa.gov>. ESDIS documents have a document number starting with either 423 or 505. Other documents are available for reference in the ESDIS project library website at: http://esdisfmp01.gsfc.nasa.gov/esdis_lib/default.php unless indicated otherwise.

1.4.1 Applicable Documents

The following documents are referenced within this document, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document.

423-SPEC-001	NASA Earth Science Data Preservation Content Specification
ISO 19115-2	ISO 19115-2 Geographic Information - Metadata. International Organization for Standardization (ISO)
ISO 19115-1	ISO 19115-1 Geographic Information - Metadata.
DIF Writer's Guide	NASA Global Change Master Directory (GCMD) Directory Interchange Format (DIF) Writer's Guide
SERF	NASA GCMD Service Entry Resource Format (SERF) Writer's Guide
CMR Life-Cycle Document	NASA ESDIS CMR Life Cycle Document

2 BASE REFERENCE METADATA MODEL

2.1 Overview

This document outlines the minimum metadata elements required to adhere to NASA Data Systems Requirements as described in the Common Metadata Repository (CMR), a high-performance, high-quality, continuously evolving metadata system. The CMR catalogs all data and service metadata records for the EOSDIS system and is the authoritative management system for all EOSDIS metadata; it utilizes the Unified Metadata Model (UMM) which defines a common set of core metadata elements across distinct metadata standards such as EOS Clearing House's (ECHO's) ECHO10 format for collection and granule metadata, Global Change Master Directory's (GCMD's) Directory Interchange Formats (DIF 10.x) for collection metadata, and the International Organization for Standardization (ISO) Geographic Information – Metadata standard 19115, parts -1 and -2, for elements that are critical for NASA collections and products. CMR and UMM adherence allows EOSDIS to provide ISO-compliant metadata for data it makes available, as depicted in the figure below.

Figure 2-3. UMM Translation

Complete descriptions of NASA collections and products require elements from all of these standards and are reflected in the following UMM metadata “profiles”: Collections (UMM-C), Granules (UMM-G), Services (UMM-S), Variables (UMM-Var), and elements that are common across UMM profiles (UMM-Common). Finalized UMMs are included as appendices to this document.

The flexibility of CMR's UMM approach enables assignment of metadata to multiple entities and elements in multiple configurations using multiple native formats. Usage of a common set of metadata entities and elements enhances interoperability across NASA missions. The entities and elements presented in this document represent a subset of what is required for NASA science data products.

NASA-specific CMR conventions shall be posted to the EOSDIS website along with tools, guides, documentation, and example implementations of the ESD metadata requirements.

(<https://earthdata.nasa.gov/about/science-system-description/eosdis-components/common-metadata-repository>)

As mentioned briefly in the introduction of this document, there are several metadata types, each designed to describe specific aspects of EOSDIS data holdings.

For each metadata type, the minimum metadata entities or elements required to describe science data products are outlined below. The metadata name and description of each metadata entity or element are listed in tabular form. In instances where top-level entities of complex metadata elements are listed, the requisite child element information is inherently required to correctly represent the parent metadata element. The role of metadata elements varies based on their scope, categorized by UMM profiles (UMM-Collections, UMM-Granules, Umm-Services, UMM-Variables, and UMM-Common for elements shared between two or more other UMM profiles).

While metadata names used in this document are not required to match the metadata names used in the mission/project data products, **all data products shall provide elements that include the required content and a mapping to vocabulary utilized in this document.** If that mapping is unclear, please contact ESDIS for help.

It is recognized that there are mission/project dependent elements that are not included in this document but should be treated as required elements for the mission/project; please refer to the UMM documentation in the appendices of this document for full details on and examples of metadata elements.

2.1.1 Series / Collections

Series/collections metadata are elements that describe an entire set of data files. Values of series/collection metadata apply to all of the files in a specific aggregate and may represent the same release of any given file, sets of data generated during an experiment, a campaign or an algorithm test. A collection is a grouping of science data that all come from the same source, such as a modeling group or institution; it may contain zero or more granules and has common information across all the granules they contain. Collections also contain a template for describing additional attributes not already part of the metadata model. CMR supports Collection ingest in the following standards/formats: UMM-C (JSON), DIF 10.x, ECHO 10, ISO 19115-2:2009 MENDS, and ISO 19115-2:2009 SMAP. The Metadata Management Tool (MMT) provides a standard-agnostic user interface to manage Collections metadata.

Required [R] UMM-C metadata elements are listed below; please see the UMM-C and/or UMM-Common appendices (423-RQMT-003-B and 423-RQMT-003-A, respectively) for more element information and examples.

Table 2-1. Required UMM- C Metadata Elements

Name	Description	Standard
ShortName [R]	“This element describes the collection short name. The short name and version id combination must be unique across the CMR. Note: The short name should not be the same as the DOI.”	UMM-C
Version [R]	“The Version element will indicate the version associated with the collection. The short name and version ID combination must be unique across the CMR.”	UMM-C
Entry Title [R]	“The EntryTitle element represents the title of the resource described by the metadata.”	UMM-Common
DOI [R]	“This element stores the DOI (Digital Object Identifier) that identifies the collection. Note: The values should start with the directory indicator which in ESDIS' case is 10. If the DOI was registered through ESDIS, the beginning of the string should be 10.5067. The DOI URL is not stored here; it should be stored as a RelatedURL. The person or organization that is responsible for creating the DOI is described in the Authority element. The person or organization is usually the DAAC or science team and not the DOI system.”	UMM-C
Abstract [R]	“Abstract provides a brief description of the resource the metadata represents. This element allows markdown-formatted text and line breaks within the text are preserved. Additional information on markdown can be found at http://en.wikipedia.org/wiki/Markdown .”	UMM-Common
DataCenter [R]	“This element describes data centers and their personnel or internal groups responsible for originating, processing, archiving, and/or distributing the data and metadata.”	UMM-C

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Name	Description	Standard
Processing Level [R]	<p>“This element contains the level identifier as described at: http://science.nasa.gov/earth-science/earth-science-data/data-processing-levels-for-eosdis-data-products. The processing levels will be described using a controlled vocabulary. The controlled vocabulary will include keywords "Not Available", "Not Applicable", and "Unknown".</p> <p>Note: This element is not currently required in any metadata format schema, but should be included in all EOSDIS collections.”</p>	UMM-C
Collection Progress [R]	<p>“Describes the production status of the dataset. There are three choices: PLANNED refers to data sets to be collected in the future and are thus unavailable at the present time. For Example: The Hydro spacecraft has not been launched, but information on planned data sets may be available. IN WORK refers to data sets currently in production or data that is continuously being collected or updated. For Example: data from the AIRS instrument on Aqua is being collected continuously. Another example is when one version of a dataset is continuously collection data such as CERES EBAF-TOA Ed2.8. COMPLETE refers to data sets in which no updates or further data collection will be made. For Example: Nimbus-7 SMMR data collection has been completed. Another example is when a legacy version of a product has been completed and no further updates will be made; such as with CERES EBAF-TOA Ed2.7.”</p>	UMM-C
Science Keywords [R]	<p>“This element enables specification of Earth Science keywords. All of the sub-elements except for DetailedVariable are controlled and use the GCMD Science Keyword vocabulary. The vocabulary is managed by the Keyword Management System (KMS) and it can be found at this location: http://gcmdservices.gsfc.nasa.gov/static/kms/sciencekeywords/sciencekeywords.csv. The DetailedVariable is an uncontrolled free text element that allows the metadata author to include another keyword to more fully describe the data.”</p>	UMM-Common
Temporal Extent [R]	<p>“This element contains sub-elements, which describe the time period in which the data set was acquired or when the measurements occurred for a specific collection. This extent can be represented in a variety of ways: RangeDateTime, SingleDateTime, or PeriodicDateTime.”</p>	UMM-Common
Spatial Extent [R]	<p>“Specifies the geographic and vertical (altitude, depth) coverage of the data.”</p>	UMM-Common
Platform [R]	<p>“This element describes the relevant platforms used to acquire the data. Platform types are controlled and since there are too many valid values to list here the following URL is provided: http://gcmdservices.gsfc.nasa.gov/static/kms/platforms/platforms.csv. The types of platforms covered include but are not limited to Aircraft, Earth Observation Satellites, In Situ Land-based Platforms, etc.”</p>	UMM-Common

Name	Description	Standard
Instrument [R]	<p>“The Instrument element is nested within the Platform element and is used to register the device that measured or recorded the data, including direct human observation. This is useful to find data from a specific instrument. Note that the use of the "Sensor" object has been removed from UMM to avoid confusion between the names "Sensor" and "Instrument" as well as rationalizing the use of Instrument with the ISO Instrument representation. To provide compatability with DIF 10 we map /DIF/Platform/Instrument/Sensor to Platform/Instrument in UMM. For ECHO 10, we also map Sensor objects to UMM Instrument objects.</p> <p>The "ComposedOf" relationship shown above provides the ability for an instrument to be composed of one or more other instruments. This hierarchical representation of Instrument composition provides the mechanism for modeling the complexity of modern instruments.”</p>	UMM-Common

2.1.2 Datasets / Granules

Datasets/granules metadata are elements that describe a single instance of a data file. Values of dataset/granule metadata apply to all of the data in that one file. Typical metadata in this category describe spatial and temporal extent of the data instance as well as the quality and lineage. A granule is the smallest aggregation of data that can be independently managed (described, inventoried, and retrieved). Granules cannot exist without being associated to a collection and support values associated with the additional attributes defined by the parent collection. CMR supports Granule ingest in the following standards/formats: ECHO 10.x and ISO 19115-2:2009 SMAP.

Required [R] UMM-G metadata elements are listed below; please see the UMM-G and/or UMM-Common appendices (423-RQMT-003-C and 423-RQMT-003-A, respectively) for more element information and examples.

Table 2-2. Required UMM- G Metadata Elements

Name	Description	Standard
Metadata Date [R]	<p>“This includes any metadata related dates.</p> <p>There are three types of dates used in the UMM profiles:</p> <ul style="list-style-type: none"> • Dates that concern the metadata record - called Metadata Dates in this document. • Dates that concern the resource itself (collections, granules, services, etc.) - called Data Dates in this document. • Dates that describe the time period in which the data set was acquired - called Temporal Extent in this document. <p>Of these three date types this element is comprised of dates for when the metadata was created, last revised, planned for future review, or planned for deletion. For dates related to the actual data or resource, the element Data Date should be used. For dates that describe the acquisition period the Temporal Extent element should be used.”</p>	UMM-Common

Name	Description	Standard
Data Date [R]	<p>“This includes any data related dates.</p> <p>There are three types of dates used in the UMM profiles:</p> <ul style="list-style-type: none"> • Dates that concern the metadata record - called Metadata Dates in this document. • Dates that concern the resource itself (collections, granules, services, etc.) - called Data Dates in this document. • Dates that describe the time period in which the data set was acquired - called Temporal Extent in this document. <p>Of these three date types this element is comprised of dates for when the data or resource itself changed in some way. It does not include the first or third bullets that describe Metadata Dates or Temporal Extent. This element is made of two sub-elements, type and date. The type describes what the date represents: a future review, when the resource was created, last updated, or planned for deletion. The date describes when the resource had an action performed on it or when an action on it will occur as described by the type element.”</p>	UMM-Common
Universal Reference Identifier [R]	<p>“The Universal Reference (UR) ID of the granule referred to by the data provider. This ID is unique per data provider and is neither a URI nor URL.”</p>	UMM-G
Parent Collection Identifier [R]	<p>“Each granule has an associated parent collection. The relationship between the granule and its parent can be specified in two ways. The next two sections of this document describe two possible options for specifying relationship between the granule and its parent.”</p>	UMM-G

2.1.3 Services

Services metadata are elements that describe the services available for a given collection. Typical metadata in this category include data transformations such as sub-setting or re-projection. Services describe a human or machine item that can be engaged to produce a product or data. CMR supports Service ingest in the following standard/formats: UMM-S (JSON). The Metadata Management Tool (MMT) provides a standard-agnostic user interface to manage Services metadata.

Required Unified Metadata Model Services (UMM-S) metadata elements are listed below; please see the UMM-S appendix (423-RQMT-003-D) for more element information and examples.

Table 2-3. Required UMM-S Metadata Elements

Name	Description	Standard
Service /Name [R]	<p>“The name of the service, software, or tool. Sample Values:</p> <ul style="list-style-type: none"> - service example: "SERVIR". - software example: "BYU_slice_response". - tool example: "USGS_TOOLS_LATLONG". - OPeNDAP example: "AIRS_L3_OPENDAP". - Mirador example: "GES_DISC_via_OpenSearch_(Mirador)": 	UMM-S
Service /LongName [R]	<p>“The long name of the service, software, or tool. It provides a human readable name for the service. Sample Values:</p> <ul style="list-style-type: none"> - service example: "Mesoamerican Visualization and Monitoring System (SERVIR)" - software example: "SeaWinds 3D Slice Response Software" - tool example: "WRS-2 Path/Row to Latitude/Longitude Converter" - OPeNDAP service example: "OPENDAP (Hyrax) framework for AIRS Level 3 data products" - Mirador service example: "Access the GES DISC data via OpenSearch (Mirador)". 	UMM-S
Service /Type [R]	<p>“The type of the service, software, or tool. Please note that Type values will come from KMS which is a controlled list. Sample Value: WCS.”</p>	UMM-S
Service /Version [R]	<p>“The edition or version of the service, software, or tool. The version should be defined in the form x, y, and z. where 'x.y.z' means 'major.minor.incremental' version numbers. Typically, 'x' and 'y' are numbers (0 through 9) and 'z' is a number (0 through 99). Sample Value: 1.1.1”</p>	UMM-S

Name	Description	Standard
Service /Description [R]	<p>“A brief description of the service, software, or tool. For example, a description might contain information about what is the service, the purpose of the service, and the parameters (or variables) being invoked, and what are the sources of these data.</p> <p>Sample Values:</p> <ul style="list-style-type: none"> - service example: "The SEDAC Hazards Mapper enables users to visualize data and map layers related to Socioeconomic, Infrastructure, Natural Disasters, and Environment and analyze potential impacts and exposure. The web app mashups layers from various sources including SEDAC, NASA LANCE, NASA GIBS, USGS, NOAA, ESRI, and others. - software example: "Imaging applications of SeaWinds on QuikSCAT and ADEOS II are facilitated by applying reconstruction and resolution enhancement algorithms to produce high resolution images of the surface normalized radar cross section (sigma-0). Such algorithms require a description of the spatial response functions of the measurements. The pencil-beam design of Seawinds, coupled with the onboard processing." - tool example: "The USGS WRS-2 Path/Row to Latitude/Longitude Converter allows users to enter any Landsat path and row to get the nearest scene center latitude and longitude coordinates. You can also enter coordinates in the second section to discover the closest Landsat path and row - daytime (descending) or nighttime (ascending)." - OPeNDAP service example: "OPeNDAP (Hyrax) Framework for AIRS L3 data products. This framework facilitates such services as format conversion and selected subsetting (e.g., spatial constraints, parameter/variable)." 	UMM-S
Service /RelatedURLs [R]	<p>“This element contains important information about the Uniform Resource Locator (URL) for the service. These include the following required elements: Name, Description and URL. The details are located in the UMM-Common document.”</p>	UMM-S
Service /ServiceKeywords [R]	<p>“Allows for the specification of Earth Science Service keywords that are representative of the service, software, or tool being described. The controlled vocabulary for Service Keywords is maintained in the Keyword Management System (KMS).</p> <p>Sample Value: "ServiceCategory: Earth Science Services, ServiceTopic: Data Management/Data Handling, ServiceTerm: Data Search and Retrieval".”</p>	UMM-S

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Name	Description	Standard
Service /ServiceOrganizations [R]	<p>“The service provider, or organization, or institution responsible for developing, archiving, and/or distributing the service, software, or tool.</p> <p>Please note that ShortName and LongName values come from KMS which is a controlled list.</p> <p>Sample Value: "Role: SERVICE PROVIDER, ShortName: SEDAC, LongName: Socioeconomic Data and Applications Center".”</p>	UMM-S
Service /ServiceContracts [R]	<p>“The ServiceContracts is the point of contact for more information about the service, software, or tool.</p> <p>ServiceContracts is a parent element to the ContactPerson and the ContactGroup elements. Its purpose is to hold shared elements that its children will use. The ServiceContracts element must exist with at least 1 of its children; it cannot exist on its own.</p> <p>The ContactPerson and the ContactGroup elements are described in detail in their respective sub-sections.”</p>	UMM-S
Service /ServiceCitation [R]	<p>“Information about citing the service resources.</p> <p>Sample Value: "Mesoamerican Visualization and Monitoring System (SERVIR) is provided by the National Space Science and Technology Center at MSFC, NASA.".”</p>	UMM-S
If Optional [O] parent fields are used, these sub-fields become Required [R]:		
Service /OperationMetadata [O] /ConnectPoint /ResourceLinkage [R]	<p>“This element contains the URL of the resource(s) coupled to this service.”</p>	UMM-S
Service /OperationMetadata [O] /OperationChainMetadata /OperationChainName [R]	<p>“This element contains the name of the operation chain made possible via this service.”</p>	UMM-S
Service /OperationMetadata [O] /Coupled Resource /DataResourceIdentifier [R]	<p>“The identifier of the layer, feature type or coverage available from the service.</p> <p>Sample Values: "sea_ice_concentration_01" or "seasonal_snow_classification" or "AIRS3STD:TotO3_D" or "AIRS3STD:SurfAirTemp_D_timeAveraged".”</p>	UMM-S
Service /OperationMetadata [O] /Coupled Resource /DataResourceType [R]	<p>“The resource type of the layer, feature type or coverage available from the service.</p> <p>Sample Values: "Variable".”</p>	UMM-S
Service /OperationMetadata [O] /Coupled Resource /DataResourceSpatialExtent [R]	<p>“The spatial extent of the layer, feature type or coverage available from the service. These are coordinate pairs which describe either the point, line string, boundingbox, general grid, or polygon representing the spatial extent.”</p>	UMM-S
Service /OperationMetadata [O] /Coupled Resource /DataResourceSpatialExtentType [R]	<p>“The type of the spatial extent of the layer, feature type or coverage available from the service.</p> <p>Sample Values: "SPATIAL_POINT".”</p>	UMM-S

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Name	Description	Standard
Service /OperationMetadata [O] /Coupled Resource /SpatialResolution [R]	“The spatial resolution of the layer, feature type or coverage available from the service. Sample Values: "10".”	UMM-S
Service /OperationMetadata [O] /Coupled Resource /SpatialResolutionUnit [R]	“The unit of the spatial resolution of the layer, feature type or coverage available from the service. Sample Values: "KM". The list will be managed as a KMS-managed list.”	UMM-S
Service /OperationMetadata [O] /Coupled Resource / DataResourceTemporalExtent [R]	“The temporal extent of the layer, feature type or coverage available from the service.”	UMM-S
Service /OperationMetadata [O] /Coupled Resource /DataResourceTemporalExtent Type [R]	“The type of the temporal extent of the layer, feature type or coverage available from the service. Sample Values: "TIME_STAMP".”	UMM-S
Service /OperationMetadata [O] /Coupled Resource /TemporalResolution [R]	“The temporal resolution of the layer, feature type or coverage available from the service. Sample Values: "1".”	UMM-S
Service /OperationMetadata [O] /Coupled Resource /TemporalResolutionUnit [R]	“The unit of the temporal resolution of the layer, feature type or coverage available from the service. Sample Values: "DAY". The list will be managed as a KMS-managed list.”	UMM-S
Service /OperationMetadata [O] /Parameter /ParameterName [R]	“This element contains the name of the parameter associated with the resource(s) coupled to this service. If there is a variable-service association, this field identifies the parameter (variable) name sourced for the service. Sample Value: "O3_ppbv”	UMM-S
Service /OperationMetadata [O] /Parameter /ParameterDirection [R]	“This element contains the direction of the parameter associated with the resource(s) coupled to this service. Sample Value: "OUT”	UMM-S
Service /OperationMetadata [O] /Parameter /ParameterDescription [R]	“This element contains the description of the parameter associated with the resource(s) coupled to this service. Sample Value: "ozone mixing ratio reported in parts per billion by volume”	UMM-S
Service /OperationMetadata [O] /Parameter /ParameterOptionality [R]	“This element contains the optionality of the parameter associated with the resource(s) coupled to this service. Sample Value: "TRUE”	UMM-S
Service /OperationMetadata [O] /Parameter /ParameterRepeatability [R]	“This element contains the repeatability of the parameter associated with the resource(s) coupled to this service. Sample Value: "TRUE”	UMM-S

2.1.4 Variables

Variable metadata are an aggregation of data from the granule that specifies a certain variable in EOSDIS data products at a specific time. Because key terms "Variable" and "Measurement" are frequently used within the Earth Science community, often with different meanings, operative definitions for the purpose of this document are as follows:

- **Measurement:** The act or process of measuring an observable property, usually geophysical. For models, it is a simulated observable property. We describe it by its name in this context. Examples: Aerosol Optical Depth, etc.
- **Variable:** An artifact that represents a measurement. We describe it by its name and characteristics in this context. The description includes what was being measured (i.e., the observable property, and how it was measured (e.g., what instrument, what resolution, what location, etc.). Examples: Aerosol Optical Depth 550nm (Dark Target), Aerosol Optical Depth 550nm (Deep Blue, Land Only), etc.

CMR supports Variable ingest in the following standard/formats: UMM-Var (JSON). The Metadata Management Tool (MMT) provides a standard-agnostic user interface to manage Variable metadata.

Required Unified Metadata Model Variable (UMM-Var) metadata elements are listed below; please see the UMM-Var appendix (423-RQMT-003-E) for more element information and examples.

Table 2-4. Required UMM-Var Metadata Elements

Name	Description	Standard
Variable /Name [R]	"A variable short name given by the data provider. Variables are available in a wide range of forms. These variables are named similarly across a family of collections, but these names differ considerably across collections. The variety of variables is illustrated using some examples across a sample of collections below."	UMM-Var
Variable /LongName [R]	"The expanded or long name given by the data provider. Sample values (given in bold) below: sea_surface_temperature (sea surface temperature)"	UMM-Var

Name	Description	Standard
Variable /Definition [R]	<p>"The definition of the variable given by the data provider. This can typically be found in the Collection User Guide corresponding to the variable.</p> <p>Ideally, it should include the details of what is being measured, the scope of the measurement and any other information to help a scientist to understand what is particular to this variable. See the Sampling class for details about the sampling method and the measurement and reporting conditions.</p> <p>Sample value: "Angstrom Exponent is an exponent that expresses the spectral dependence of aerosol optical thickness (τ) with the wavelength of incident light (λ). The spectral dependence of aerosol optical thickness can be approximated (depending on size distribution) by, $\tau_a = \beta \lambda^\alpha$ where α is Angstrom exponent (β = aerosol optical thickness at 1 μm)."</p>	UMM- Var
Variable / Unit [R]	<p>"The unit used to report the variable.</p> <p>The list of units will be sourced from the Dataset Interoperability Working Group (https://wiki.earthdata.nasa.gov/display/ESDSWG/Dataset+Interoperability+Working+Group)</p> <p>The list will be managed as a KMS-managed list."</p>	UMM- Var
Variable /DataType [R]	"Specifies the basic computer science data type of a variable. These types can be either short, long, character, binary, etc."	UMM- Var
FillValues /Value [R]	<p>"The fill value of the variable in the data file.</p> <p>Sample values: -9999."</p>	UMM- Var
FillValues /Type [R]	<p>"Type of the fill value of the variable in the data file.</p> <p>Sample values: Science"</p>	UMM- Var
Dimensions /Name [R]	"The name of the dimensions of the variable represented in the data field. For example, 'XDim'."	UMM- Var
Dimensions /Size [R]	"The size of the dimensions of the variable represented in the data field. For example, '1200'."	UMM- Var
Sets /Name [R]	"This element enables specification of set name. For example, 'Data_Fields'."	UMM- Var
Sets /Type [R]	"This element enables specification of set type. For example, if the variables have been grouped together based on a particular theme, such as wavelength, then the type should be set to that theme, otherwise it should be set to 'General'."	UMM- Var
Sets /Size [R]	"This element specifies the number of variables in the set. For example, if the number of variables in the set is fifteen, the size should be recorded as '15'."	UMM- Var
Sets /Index [R]	"This element specifies the index value within the set for this variable. For example, if this variable is the third variable in the set, the index value should be '3'."	UMM- Var
Sampling /SamplingMethod [R]	"The name of the sampling method used for the measurement. For example, 'radiometric detection within the visible and infra-red ranges of the electromagnetic spectrum'."	UMM- Var
If Optional [O] parent fields are used, these sub-fields become Required [R]:		

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Name	Description	Standard
ScienceKeywords [O] /Category [R], /Topic [R], /Term [R]	“These elements describe controlled science keywords describing the measurements/variables. The controlled vocabulary for Science Keywords is maintained in the Keyword Management System (KMS). These will be sourced from GCMD Keywords.”	UMM- Var
FillValues [O] /FillValue [R]	“The fill value of the variable in the data file. It is generally a value which falls outside the valid range. For example, if the valid range is '0, 360', the fill value may be '-1'. The fill value type is data provider-defined. It is typically a value out of valid range, although some cases have been reported of exceptions to this rule. The fill value of the variable in the data file.”	UMM- Var
FillValue [O] /Type [R]	“The fill value of the variable in the data file. It is generally a value which falls outside the valid range. For example, if the valid range is '0, 360', the fill value may be '-1'. The fill value type is data provider-defined. It is typically a value out of valid range, although some cases have been reported of exceptions to this rule. Type of fill value of the variable in the data file.”	UMM- Var
Measurements [O] /MeasurementName [R], /Object [R], /Quantity [R]	<p>The names of the measurement may be taken from a variety of sources. These include, but are not limited to, Community Surface Dynamics Modeling System (CSDMS) Cross Domain Naming Conventions or Climate and Forecast (CF) Standard Name Convention, British Oceanographic Data Centre (BODC).</p> <p>According to the CSDMS Basic Rules, every standard name has an object part that describes a particular object and a quantity part that describes a particular attribute of that object that can be quantified with a number. These names are sorted alphabetically, but other sorting methods can be added later.</p> <p>Names are of the form: <object>__<quantity>.</p> <p>Names shall contain only lowercase letters and numbers along with the Standard Names separator characters (__, -, ~, __).</p> <p>The Standard Names separators:</p> <p>_: delimiter separate words of a name.</p> <p> -: join multi-word objects, quantities, adjectives, etc.</p> <p>~: join an adjective to a noun (the noun comes first following by or more adjectives).</p> <p>__: separate an object from a quantity.</p> <p>_of_: apply a math operation to the subsequent quantity.</p> <p>Qualifiers that make an object or quantity more specific are added to the left of the base object or quantity (with increasing specificity).</p> <p>CSDMS Standard Names may be further grouped by category: Atmosphere, Oceans, Radiation, Sea Ice, Soil, Snow, Topography.</p> <p>This is defined more fully in the CSDMS Wiki: https://csdms.colorado.edu/wiki/CSN_Basic_Rules</p>	UMM- Var

3 ABBREVIATIONS AND ACRONYMS

ADEOS II	ADvanced Earth Observing Satellite 2
AIRS L3	Atmospheric Infrared Sounder
API	Application Programming Interface
BODC	British Oceanographic Data Centre
CCB	Configuration Change Board
CCR	Configuration Change Request
CERES	Clouds and Earth's Radiant Energy Systems
CF	Climate and Forecast
CMO	Center Management and Operations
CMR	Common Metadata Repository
CSDMS	Community Surface Dynamics Modeling System
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
DIF	Directory Interchange Formats
EBAF	Energy Balanced and Filled
ECHO	EOS Clearing House
ECS	EOSDIS Core System
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESD	NASA Earth Science Division
ESDIS	Earth Science Data and Information System
ESDS	Earth Science Data Systems
ESRI	Environmental Systems Research Institute
GCMD	Global Change Master Directory
GES DISC	Goddard Earth Sciences Data and Information Services Center
GIBS	Global Imagery Browse Services
GITC	GIBS in the Cloud
GSFC	Goddard Space Flight Center
ISO	International Organization for Standardization
KMS	Keyword Management System
LANCE	Land, Atmosphere Near real-time Capability for EOS
MENDS	Metadata Evolution for NASA Data Systems
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
QuikSCAT	Quick Scatterometer
SEDAC	Socioeconomic Data and Applications Center
SERF	Service Entry Resource Format
SMAP	Soil Moisture Active Passive
SMMR	Scanning Multichannel Microwave Radiometer
TBD	To Be Determined
TBS	To Be Supplied
TOA	Top-of-Atmosphere
UMM	Unified Metadata Model

UMM-C	UMM-Collections
UMM-G	UMM-Granules
UMM-S	UMM-Services
UMM-Var	UMM-Variables
UR	Universal Reference
URI	Universal Resource Identifier
URL	Uniform Resource Locator
USGS	United States Geological Survey
XML	Extensible Markup Language
XSD	XML Schema Definition